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A NEW SPECIES OF *MARSHALLIA* (ASTERACEAE, HELENIEAE, MARSHALLIINAE) FROM MAFIC WOODLANDS AND BARRENS OF NORTH CAROLINA AND VIRGINIA

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ABSTRACT

A new species of *Marshallia* (Asteraceae, Helenieae, Marshalliinae) is proposed and contrasted with the morphologically most similar and putatively most closely related species, *M. grandiflora* and *M. obovata*. The new species is known from a few sites in the Piedmont of north-central North Carolina and south-central Virginia, occurring solely or primarily in remnants of fire- and edaphically maintained oak savannas, barrens, and "prairies" developed over cation-rich, shrink-swell clay soils derived from the mafic rocks diabase and greenstone.

KEY WORDS: *Marshallia legrandii, Marshallia obovata, Marshallia grandiflora,* Asteraceae, Helenieae, North Carolina, Virginia, Georgia, Florida, southeastern United States, endemic, imperiled

Marshallia Schreber is a small genus (7–11 taxa) endemic to the southeastern USA (interpreted broadly), with species extending as far north as southwestern Pennsylvania and as far west as southeastern Kansas, central Oklahoma, and central Texas. It has long been regarded as distinctive, enigmatic, and "strange" (Baldwin 2009), with contrasting assessments of its closest generic relatives and tribal placement. Beadle & Boynton (1901) published the first comprehensive account of the genus and established the foundation for an understanding of its component species, naming three species (each of them rare and local: *M. grandiflora* Beadle & Boynton, *M. mohrii* Beadle & Boynton, and *M. ramosa* Beadle & Boynton) and recognizing a total of 11 taxa (7 species, with 4 additional varieties). Building on this, Channell (1957) monographed the genus, largely agreeing taxonomically with Beadle & Boynton (1901), recognizing 10 taxa (8 species, with 2 additional varieties), by elevating one of Beadle & Boynton's (1901) varieties to specific rank (*M. tenuifolia*) and dismissing another (*M. graminifolia* var. *lacinarioides*). In the half-century since Channell (1957), the most notable work on the genus has been by Linda Watson, James Estes, and collaborators, who published a series of publications in the early 1990s exploring the taxonomy of members of the genus and its tribal affinities (Watson & Estes 1990; Watson, Elisens, & Estes 1991; Watson, Jansen, & Estes 1991).

Recent floristic works have generally followed the framework established by Channell (1957), with minor but significant diversity of opinion about the worth of recognition of some varieties or their taxonomic rank. Cronquist (1980) followed Channell exactly (8 species, 2 additional varieties). In her Flora of North America treatment, Watson (2006) formally recognized 7 species, providing characters and distributions for three additional varieties, apparently considered them of uncertain or optional taxonomic value. A consensus list of taxa accepted in the genus in the early 21st century would include these: *M. caespitosa* Nutt. ex DC. var. *caespitosa*, *M. caespitosa* Nutt. ex DC. var. *signata* Beadle & Boynton, *M. graminifolia* (Walt.) Small, *M. tenuifolia* Raf., *M. grandiflora* Beadle & Boynton, *M. mohrii* Beadle & Boynton, *M. obovata* (Walt.) Beadle & Boynton var. *obovata*, *M. obovata* (Walt.) Beadle & Boynton var. *scaposa* Channell, *M. ramosa* Beadle & Boynton, and *M. trinervia* (Walt.) Trel.

In 1986, North Carolina Natural Heritage Program biologist Harry E. LeGrand, Jr. found an unusual population of *Marshallia* near Butner, Granville County, North Carolina. This *Marshallia* was found in a dry, mafic barren over diabase in a site since dubbed the Picture Creek Diabase Barren (North Carolina Natural Heritage Program). LeGrand tentatively identified the Picture Creek *Marshallia* using existing floristic treatments (Radford, Ahles, & Bell 1968; Cronquist 1980) as *M. grandiflora* Beadle & Boynton, but noted that the identification was not definite or satisfying (North Carolina Natural Heritage Program 1986). The mention in Radford, Ahles, & Bell (1968) of *M. grandiflora* as occurring in Granville County made this new record seem plausible, though the habitat given ("bogs") was less felicitous. A review of specimens at the University of North Carolina Herbarium (NCU) by the first author revealed the specimen on which this record was based (NCU 225014: Granville County: Bog, 1.5 mi E of Hester, *A.E. Radford 43945*, 16 Jun 1961), and that this specimen matched the material found by LeGrand at Butner and differed morphologically from *M. grandiflora* in the same ways. Attempts by the first author in the late 1980s and early 1990s to relocate the Picture Creek population were unsuccessful.

In 1971 and again in 1980, A.M. and B.J. Harvill collected what they considered to be *Marshallia obovata* slightly to the north of the Picture Creek locality in Halifax County of south-central Virginia (collections cited below). One of the sites where the *Marshallia* was collected, Difficult Creek, became a land conservation project by the Virginia Department of Conservation, and the populations of the state rare "*M. obovata*" came under greater scrutiny from biologists of the Virginia Division of Natural Heritage, who found that populations of both *M. obovata* and the putative new species from Picture Creek were present, morphologically distinguishable and phenologically offset from one another (Figure 1). In both North Carolina and Virginia, the undescribed taxon has been informally accepted as a species warranting conservation tracking and monitoring (Buchanan & Finnegan 2010; Townsend 2009).

Taxonomy. With four known populations (of which two are known to be extant, and two historical and possibly extirpated), this morphologically distinctive entity, associated with a distinctive habitat, phenologically separated from sympatric and syntopic populations of its congener *M. obovata*, highly imperiled by its rarity and the need for fire management of its habitat, warrants taxonomic recognition.

Marshallia legrandii Weakley, sp. nov. (Figure 2). **USA. North Carolina.** Granville Co.: Picture Creek Diabase Barren, N of Butner, 22 Jul 2003, *A.S. Weakley 7274 with L.M. Giencke and J.P. Perry III* (holotype: NCU; isotypes: AUA, MO, NCSC, NCU, NY, US).

Paratypes: **USA. North Carolina.** Granville Co.: Bog, 1.5 mi E of Hester, *Radford 43945*, 16 Jun 1961 (NCU 225014). **Virginia.** Halifax Co.: Oak-pine woods 1 mi S of Difficult Creek on Rt. 719, 25 Jun 1972, *Harvill 25539* (FARM [2 sheets], VPI 85782); border of dry, cut-over oak-hickory woods over basic rock, along SE side of Rt. 719, 1.1 mi SW of bridge over Difficult Creek, 3.3 mi E of Scottsburg, elev. 490 ft, common, 1 Jun 1995, *Fleming 10448* (VPI 90521); Difficult Creek Heritage Preserve, mafic flats E of County Road 719, habitat mafic woodlands, 27 Jun 2003, *Weakley 7255* (NCU 568186, NCU 569188); roadside 3 mi E of Halifax, 9 Jun 1980, *Harvill 41178* (LYN 42010). Known stations for the species are shown in Figure 3.

Perennial, 60–80(–100) cm, fibrous-rooted, from caudices, and forming basal offsets. **Stems** erect, unbranched, striate, especially immediately below the head. **Leaves** basal and cauline, alternate; the first basal (most proximal) leaves often withering by anthesis, 1/3–1/2 as long as the next most proximal and longest basal and low cauline leaves, these longest leaves 15–25(–32) cm long (including the long petiole-like basal taper) and 7–20 mm wide, the apex acute to acuminate (rarely narrowly obtuse), the longest leaf on a plant (usually low cauline) 15–30 cm long, the leaves

gradually reduced upwards, extending 2/3 to 4/5 of the length of the stem; well-developed blades prominently 3-nerved, lanceolate to oblanceolate (sometimes linear-oblanceolate. **Heads** strictly single. **Involucres** hemispheric to obconic, 20–25 mm in diameter (as measured phyllary tip to phyllary tip). **Phyllaries** 8–11 mm long, the broadest (outermost) phyllaries 2.5–3.7 mm wide, grading into narrower phyllaries inwards (and eventually into paleae), the apices acute to broadly acute, the distal surface densely glandular with both impressed glands and raised resin dots (Figure 4). **Paleae** acute-acuminate and only gradually and slightly dilated towards the apex, the distal surface glandular with both impressed glands and raised resin dots. **Corollas** pale to deep pink (Figure 5), lobes 5–7.5 × 0.7–1.1 mm. **Cypselae** mostly 3.0-3.2 mm long × mostly 1.5–1.6 mm wide (near the apex) and 0.8 mm wide (near the base), strigose, 5-angled, 10-ribbed. **Pappus scales** 1.1–1.3 mm long, scarious or hyaline, glabrous to scaberulous on the distal surfaces, the margins entire to scabridulous.

Marshallia legrandii is readily distinguished from most members of the genus by the following features. Plants strictly single-headed (separating it from *M. graminifolia*, *M. tenuifolia*, *M. ramosa*, *M. mohrii*, *M. caespitosa* var. *signata*), leaves basally disposed (separating it from *M. trinervia*), stem pubescent at least in the scapose portion below the head(s) (separating it from *M. trinervia*), corollas pale to deep pink (separating it from *M. obovata* var. *obovata*, *M. obovata* var. *scaposa*, *M. ramosa*, *M. caespitosa* var. *caespitosa*, *M. caespitosa* var. *signata*). *M. legrandii* shows closest similarities to *M. obovata* var. *obovata* and *M. grandiflora* but is readily separable from each.

Marshallia legrandii differs from *M. obovata* var. *obovata* in its greater stature (usually 6–9 dm tall vs. usually 3–5 dm tall), its larger heads (Figure 4), its corolla color (pale to deep pink vs. white to very pale pink; Figures 4, 5, 6, 7, 8), the greater length of the lower leafy portion of its stem (23–50 cm long vs. 5–30 cm long; Figures 2, 5, 10), its later flowering (June-July vs. April-early June; Figure 1) even when growing at the same site, the shape of its basal and lower cauline leaves (narrowly oblanceolate, mostly 15–25 cm long including the petiole, mostly 7–20 mm wide, averaging about 10–20× as long as wide including the petiole, the apex acute to acuminate, vs. obovate to oblanceolate, mostly 6–10 cm long, mostly 8–14 mm wide, averaging about 6–10× as long as wide, the apex obtuse to rounded and often emarginated; Figures 2, 5, 10), the reduction upwards of the size of the stem leaves (gradually reduced upwards, several of the uppermost leaves <½ as long and as wide as the largest lower stem leaves, vs. the uppermost stem leaves only slightly smaller than the largest lower stem leaves, excepting sometimes 1-2 greatly reduced bracts; Figures 2, 5, 10), the apex shape of the outer phyllaries (acute or acutish vs. obtuse to rounded; Figure 9), the apex shape of the paleae (acute-acuminate and not or gradually dilated towards the apex vs. acute and distinctly and abruptly dilated; Figure "7"), and the glandularity of the outer surface of the phyllaries and paleae (with abundant resin glands vs. with few or no resin glands) (Figures 4, 9).

Marshallia legrandii differs from *M. grandiflora* in the size and shape of the basal and lower cauline leaves (mostly 15–25 cm long including the petiole, mostly 7–12 mm wide, averaging about 20× as long as wide including the petiole, the apex acute to acuminate, vs. mostly 3–13 cm long including the petiole, mostly 10–20 mm wide, averaging about 6× as long as wide including the petiole, the apex obtuse to rounded; Figures 2, 5, 11), pappus scale size (ca. 1.2 mm long vs. ca. 2 mm long), plant stature (mostly 6–9 dm tall vs. 3–5 dm tall); achene vestiture (with copious resin-dots between the ridges vs. without resin dots between the ridges; Figure 9), and distribution and habitat (of mafic woodlands and barrens of the Piedmont of southcentral Virginia and northcentral North Carolina, vs. of flood-scoured riverbanks, floodplain forests, and bog margins of the Alleghany and Cumberland Plateaus of southwestern Pennsylvania, West Virginia, eastern Kentucky, and eastern Tennessee, rarely east to the Blue Ridge of southwestern North Carolina; Figure 3).

Figure 1. Phenological contrast of *Marshallia obovata* var. *obovata* and *M. legrandii*, Difficult Creek, 16 June 2009; photos by Irv Wilson. A. *Marshallia obovata* var. obovata, in early to middle fruiting B. *Marshallia legrandii*, in mid-flower (outer flowers withering, inner flowers not yet open.

Figure 2. Holotype of *Marshallia legrandii* Weakley.

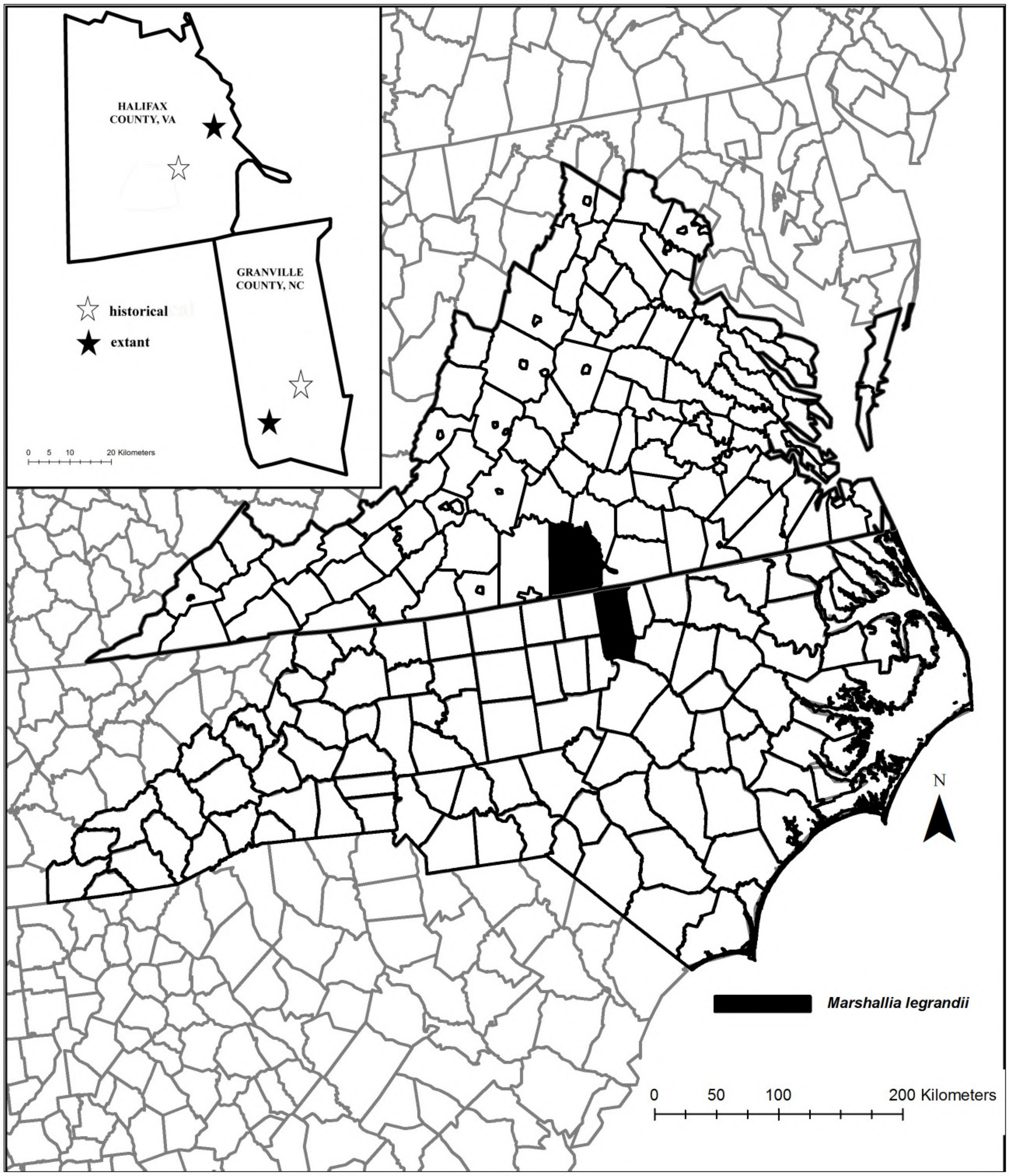

Figure 3. Documented distribution of *Marshallia legrandii*.

Etymology. The first author chooses to name this species for his colleague Harry E. LeGrand, Jr., for three reasons.

1) LeGrand first found and recognized the unusual morphology and importance of the population at the Picture Creek Diabase Barren, leading ultimately to this re-evaluation. Although the species had been collected thrice before (by Radford in 1961 and by Harvill & Harvill in 1972 and 1980), it is quite likely that its distinctive features would have gone unnoticed without LeGrand's careful observations from the fourth and by far the largest population known to date.

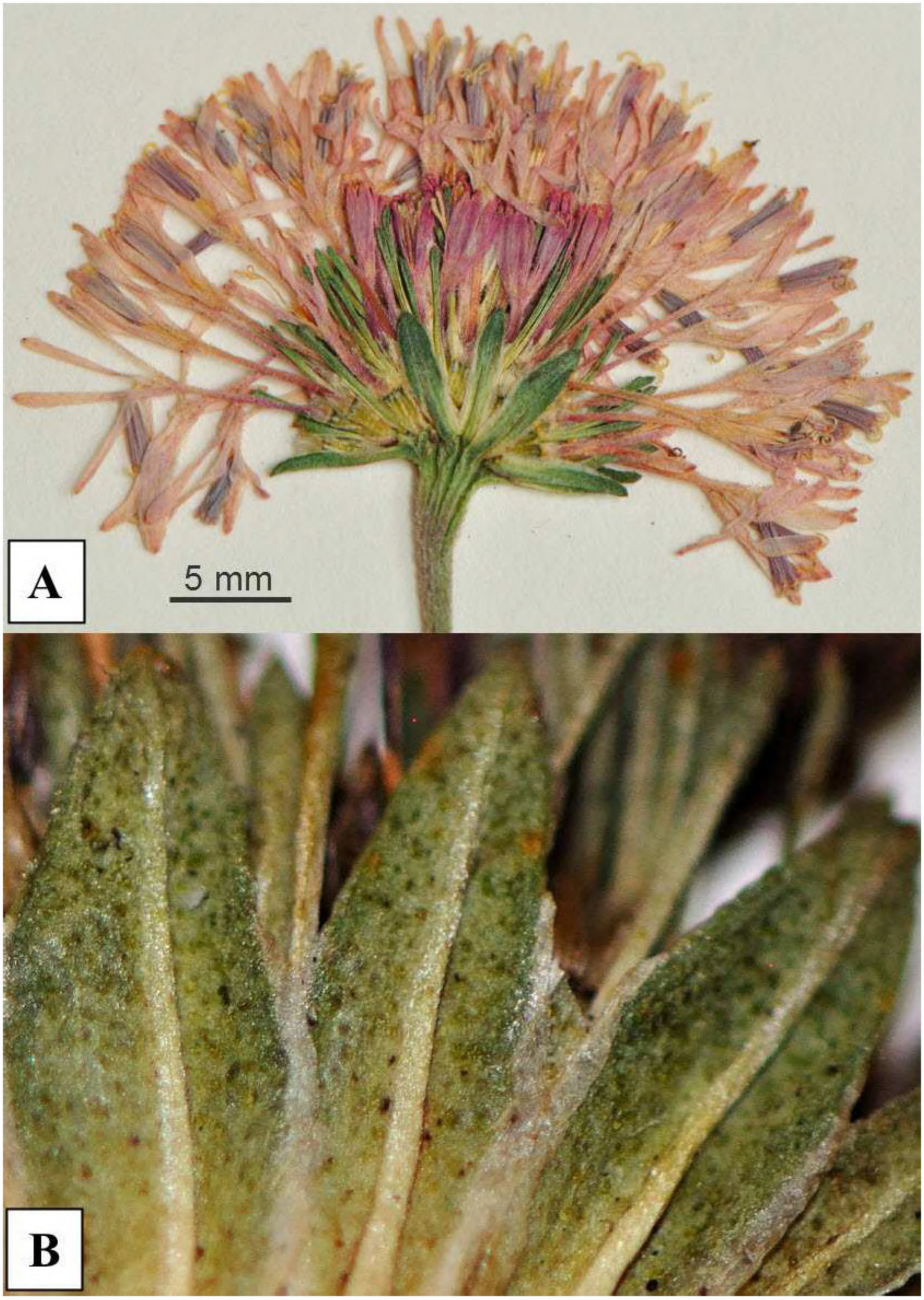

Figure 4. A. Flowering head of *Marshallia legrandii*. Head is 4.3 cm wide, from flower tip to flower tip. Paratype from Difficult Creek. B. Closeup of phyllaries of *Marshallia legrandii*, showing strongly glandular distal surface. Holotype.

Figure 5. Flowering specimen of *Marshallia legrandii*. Paratype, from Difficult Creek.

Figure 6. Head of *Marshallia legrandii* from below, showing phyllaries (shape and glandularity) and medium pink corollas. Photograph by Curtis Hansen, June 11, 2012, Picture Creek.

2) Over the course of his career with the North Carolina Natural Heritage Program (28 years and counting), LeGrand has had an instrumental role in the discovery and protection of numerous natural areas in North Carolina, especially in the Piedmont. Perhaps none of his discoveries have been more important than the various "diabase natural areas" he discovered and documented in the

course of the Superconducting Supercollider Survey (North Carolina Natural Heritage Program 1986), including the Picture Creek Diabase Barren and the Butner Diabase Glade, from which another new species, *Phemeranthus piedmontanus* S. Ware, was recently named (Ware 2011).

3) *Marshallia legrandii* is indeed "*le grand*" *Marshallia*, taller than *M. obovata*, with which it has been confused, and among the tallest species in the genus.

Figure 7. Head of *Marshallia legrandii* from above, showing paleae and medium pink corollas. Photograph by Curtis Hansen, June 11, 2012, Picture Creek.

Habitat. The two known extant sites (Picture Creek Diabase Barren and Difficult Creek Natural Heritage Preserve) for *Marshallia legrandii* have notable similarities, in being remnants of mafic woodlands, savannas, or prairies that were once relatively common in the southeastern Piedmont (Noss 2012). Diabase, greenstone, and other mafic rocks in the southeastern Piedmont weather to clay-rich soils with hardpan characteristics, in which extreme fluctuations of soil moisture availability, cracking of soil during dry periods, flat landscapes creating large natural fire compartments, and occasional fires set by lightning and humans maintained "prairie-like" conditions suitable for calciphilic heliophytes. Such sites have been described as "Piedmont prairies" and are of great conservation, ecological, and biogeographic interest, because of their large numbers of narrowly endemic or highly disjunct and regionally rare plant species (Barden 1997; Davis et al. 2002; Noss 2012). The habitats present at the third and fourth sites are more difficult to assess because they lack known extant populations of *Marshallia legrandii*; the Hester location is over mafic rocks (diabase),

while Harvill's "3 miles E of Halifax" collection appears not to be based on coarse-scale geologic mapping, but has not been searched for and the locality is rather vague.

Figure 8. Habitat aspect of *Marshallia legrandii* at Picture Creek (type locality). Photograph by Curtis Hansen, June 11, 2012.

The Picture Creek Diabase Barren features many narrowly endemic and disjunct species tracked as rare by the North Carolina Natural Heritage Program and listed as Threatened or Endangered by the United States Fish and Wildlife Service and the North Carolina Plant Conservation Program (Buchanan & Finnegan 2010). Among the notable species co-occurring with the unusual population of *Marshallia* at the Picture Creek Diabase Barren are *Solidago rigida* var. *glabrata*, *Solidago ptarmicoides*, *Symphyotrichum depauperatum*, *Echinacea laevigata*, *Carex meadii*, *Silphium terebinthinaceum*, *Baptisia australis* var. *aberrans*, *Ruellia humilis*, *Eryngium yuccifolium* var. *yuccifolium* (North Carolina Natural Heritage Program 1986; Buchanan & Finnegan 2010; all nomenclature and taxonomic concepts follow Weakley 2012). This set of species collectively is a mixture of very narrow endemics, broader endemics, and Midwestern disjuncts all associated with the regionally rare (in the Piedmont) combined conditions of 1) circumneutral soils with high base status, 2) frequent fire (at least historically), and open-canopy, sunny conditions.

The Picture Creek community type is classified as the *Quercus stellata - (Pinus echinata) / Schizachyrium scoparium - Echinacea laevigata - Oligoneuron album* Woodland or Xeric Hardpan Forest (Northern Prairie Barren Subtype), given a G1 conservation rank, the most highly imperiled ranking possible in the NatureServe conservation ranking system (Schafale 2012; NatureServe 2012; Slapcinsky 1994). Highlighting the unusual edaphic conditions at the site is the classification of the

soil at the site as a narrowly endemic series, the Picture series, a fine, smectitic, thermic Vertic Argiaquoll (Natural Resources Conservation Agency 2012).

Similarly, the Difficult Creek Natural Heritage Preserve supports relict communities determined by montmorillonitic soils derived from mafic and ultramafic rock and the historic occurrence of fires maintaining an open canopy. Though much of the site was altered by conversion to loblolly pine plantations in the 1980s, remnant patches of more natural vegetation remained, and some of the heliophytic species were able to persist in these sites and along roadsides, powerline rights-of-way, and a gas line right-of-way through the area. Now, with the area being restored by selective tree removal and prescribed fires, heliophytic taxa are reoccupying suitable habitats. The vegetation at the site is classified as a *Quercus stellata - Carya (septentrionalis, glabra) - (Quercus marilandica) / Ulmus alata / (Schizachyrium scoparium - Piptochaetium avenaceum)* Woodland [= CEGL003714] (NatureServe 2012) or one of the Piedmont Hardpan Forest types in the Virginia community classification: *Quercus stellata - Quercus alba - Carya glabra / Ulmus alata / Piptochaetium avenaceum - Scleria oligantha* Forest (Southern Piedmont Hardpan Forest) (Fleming & Patterson 2012).

Among the unusual and at least regionally rare taxa occurring with or near the *Marshallia* at Difficult Creek are *Echinacea laevigata*, *Eryngium yuccifolium* var. *yuccifolium*, *Marshallia obovata* var. *obovata*, *Gillenia stipulata*, *Cirsium carolinianum*, *Dichanthelium annulum*, *Anemone berlandieri*, *Lythrum alatum*, *Rhynchospora harveyi*, *Carex meadii*, *Tragia urticifolia*, *Ambrosia bidentata*, *Symphyotrichum laeve* var. *concinnum*, and others (G.P. Fleming, pers. comm. 2012; J.C. Ludwig, pers. comm. 2012; J.R. Townsend, pers. comm. 2012).

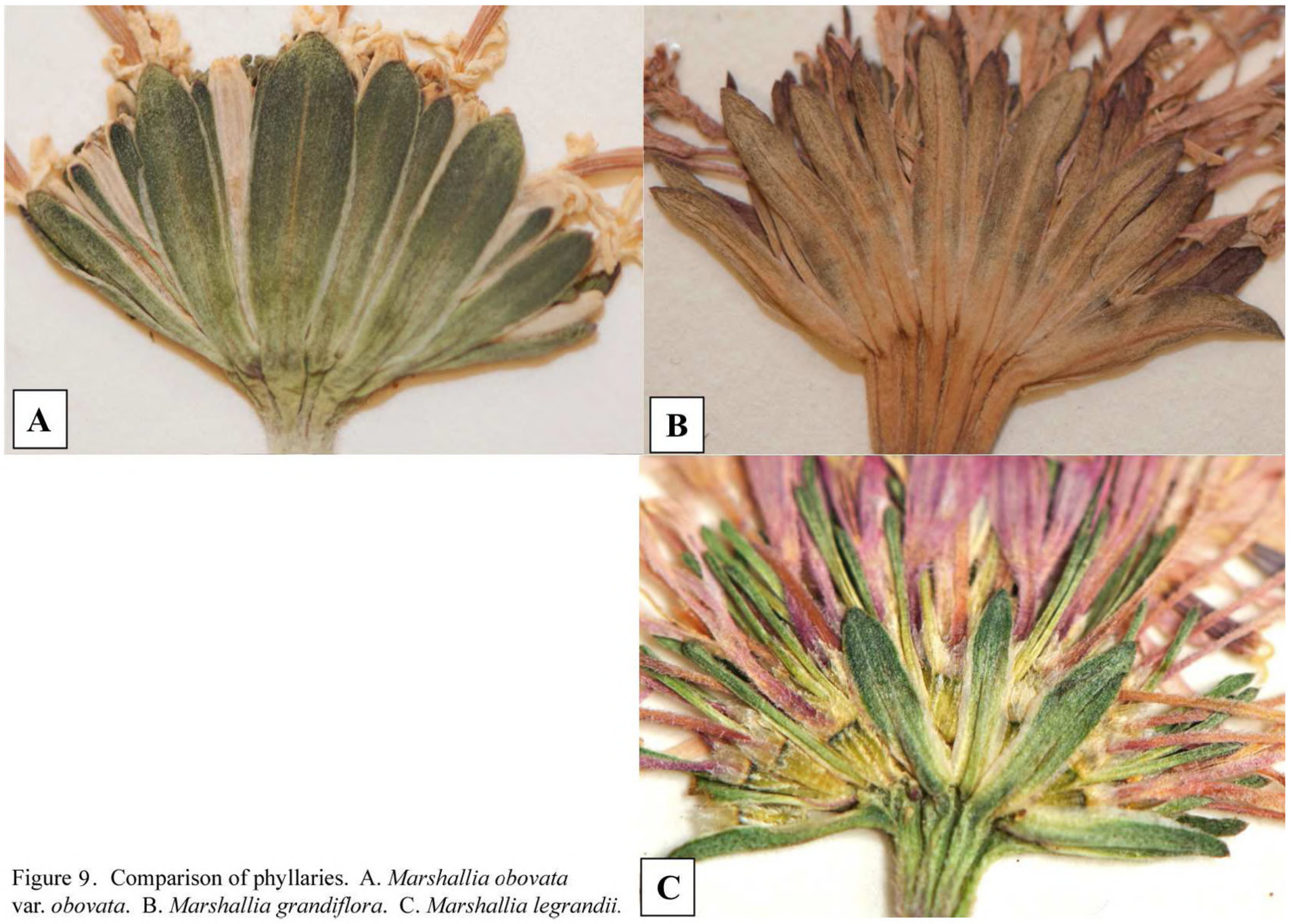

Figure 9. Comparison of phyllaries. A. *Marshallia obovata* var. *obovata*. B. *Marshallia grandiflora*. C. *Marshallia legrandii*.

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HERBARIUM
NCU
585017
Flora of the Southeastern United States of America
State: North Carolina Family: ASTERACEAE
County: Orange
Taxon: Marshallia obovata (Walt.) Beadle & F.E. Boynt. var. obovata
Location: Dry roadside, SE corner of SR 1106 (Orange Grove Road) and SR 1127 (Borland Road), south of Hillsborough.
Notes: Unusually good blooming year for Marshallia. NC Dept. of Transportation has installed wooden stakes at this corner so that it is not mown and mowing equipment is not parked on top of it. Associated species: Aletris farinosa.
Collector(s): Carol Ann McCormick s.n.
Date: 20 May 2008
University of North Carolina Herbarium (NCU)
Chapel Hill, North Carolina, U.S.A.
UNIVERSITY OF NORTH CAROLINA HERBARIUM
NCU00094221

Figure 10. Representative example of *Marshallia obovata* var. *obovata.*

Figure 11. Representative example of *Marshallia grandiflora*.

A New Key. We offer the following key to *Marshallia* with single heads and basally disposed leaves. A comprehensive key to the genus *Marshallia* will be provided in the near future.

1. Leafy portion of the stem 23–50 cm long, the naked peduncle 0.4–1.2× as long as the leafy portion of the stem; stem leaves reduced upward, the uppermost < 1/3 as long and wide as the largest leaves on the plant; basal leaves obovate to oblanceolate, the apex obtuse to acute or acuminate; outer well-developed phyllaries with acute to obtuse apex, the outer surface with abundant resin glands; corollas medium pink; flowering early June–July.

    2. Basal and lower cauline leaves (2–)3–13(–20) cm long (including the petiole), (5–)10–20(–30) mm wide, averaging about 6× as long as wide (including the petiole), the apex obtuse to rounded; pappus scales 1.5–2.2 mm long; plants (2–)3–5(–8.5) dm tall; achenes with absent or scattered resin dots between the ridges; Mountains of sw PA, WV, e KY, e TN and sw NC ..... **Marshallia grandiflora**
    2. Basal and lower cauline leaves 15–25(–32) cm long (including the petiole), (3–)7–12(–15) mm wide, averaging about 10× as long as wide (including the petiole), the apex acute to acuminate; pappus scales 1.0–1.3 mm long; plants (4–)6–9(–10) dm tall; achenes with copious resin dots between the ridges; Piedmont of nc NC and sc VA..... **Marshallia legrandii**

1. Leafy portion of the stem 0–20(–30) cm long, the naked peduncle 1.5–10× (or more) as long as the leafy portion of the stem; stem leaves (if present) not reduced upward, the uppermost > 1/2 as long and wide as the largest leaves on the plant; basal leaves obovate to oblanceolate, the apex obtuse to rounded (often emarginate); outer well-developed phyllaries with obtuse to rounded apex, with or without resin glands; corollas white to very pale pink; flowering late April–May(–early June).

    3. Outer phyllaries lanceolate, apices both conspicuously tapered and apiculate; shale barrens, hillsides, and rocky limestone slopes, of se TX, w LA, e OK, se KS, nw AR, and sw MO ..... **Marshallia caespitosa** var. **caespitosa**
    3. Outer phyllaries oblong-obovate, apices conspicuously rounded (though often also apiculate); glades, barrens, roadbanks, and mesic longleaf pine savannas of sc VA, NC, SC, GA, AL, and Panhandle FL.

        4. Plant with 3–10 leaves on the lower stem, extending (5–)8–20(–30) cm up the stem; pappus scales (0.5–)0.7–1.2(1.5) mm long; plant (2–)3–5(–7) dm tall; outer surface of phyllaries and paleae generally lacking sessile resin glands (occasionally with a few punctate glands); Piedmont and rarely Coastal Plain from sc VA southward ... **Marshallia obovata** var. **obovata**
        4. Plant scapose (all of the leaves basal) or nearly scapose, with 1–5 leaves extending 1–5(–10) cm up the stem; pappus scales (1.0–)1.5–2.5(–3.0) mm long; plant (0.5–)1.5–3.5(–5.0) dm tall; outer surface of phyllaries and paleae with many punctate and sessile resin glands; Coastal Plain and rarely outer Piedmont from NC southward ..... **Marshallia obovata** var. **scaposa**

Future Studies. The authors and collaborators plan additional studies to resolve the appropriate taxonomic ranks of taxa in the "*caespitosa*," "*scaposa*," and "*graminifolia*" complexes. Curtis Hansen (AUA) has initiated molecular phylogenetic studies that should help resolve relationships in the genus and clarify the roles of allopolyploidy, autopolyploidy, and allopatric differentiation and speciation in the genus.

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